US005864435A

United States Patent [19]

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[11] **Patent Number:** **5,864,435**

[45] **Date of Patent:** **Jan. 26, 1999**

[54] **COMPACT WIDE-ANGLE ZOOM LENS**

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[21] Appl. No.: **946,072**

[22] Filed: **Oct. 7, 1997**

[30] **Foreign Application Priority Data**

Nov. 19, 1996 [JP] Japan 8-324586

[51] **Int. Cl.^{6}** **G02B 15/14**; G02B 3/02; G02B 9/04

[52] **U.S. Cl.** **359/692**; 359/691; 359/717; 359/795

[58] **Field of Search** 359/691, 692, 359/717, 795

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[57] **ABSTRACT**

In a compact wide-angle zoom lens having a two-group configuration composed of positive and negative lens groups, each lens is set to have a predetermined form and satisfy a predetermined range of conditional expression, thereby attaining a high brightness at its wide-angle end, a large angle of view, and a small lens thickness at its telephoto end. The first lens group comprises a biconcave negative first lens L_1; a cemented lens composed of a negative second lens L_2 and a biconvex positive third lens L_3; and a biconvex positive fourth lens L_4. The second lens group comprises a fifth lens L_5 having an aspheric surface; a sixth lens L_6 having a positive meniscus form with a convex surface directed onto the image side; and a seventh lens L_7 having a negative meniscus form with a convex surface directed onto the image side. The zoom lens further satisfies the following conditional expressions:

$$0<(r_3+r_4)/(r_3-r_4)<3.5, \ 0.5<(r_{11}+r_{12})/(r_{11}-r_{12}) <4.5, \ 0.9<|r_5/r_4|<2.3,$$
$$n_1>1.65, \ n_4<1.57$$

wherein

r_3 is the radius of curvature of the object-side surface of said second lens

r_4 is the radius of curvature of the image-side surface of said second lens

r_5 is the radius of curvature of the image-side surface of said third lens

r_{11} is the radius of curvature of the object-side surface of said sixth lens

r_{12} is the radius of curvature of the image-side surface of said sixth lens

n_1 is the refractive index of said first lense

n_4 is the refractive index of said fourth lense

3 Claims, 15 Drawing Sheets

FIG.1

FIG.2

EXAMPLE 2

FIG.3

EXAMPLE 3

OBJECT —→

←— IMAGE

W

T

F I G. 4

EXAMPLE 4

F I G. 5

EXAMPLE 5

FIG.6C
EXAMPLE 1
WIDE-ANGLE
END
ω=36.6°
DISTORTION (%)

FIG.6B
EXAMPLE 1
WIDE-ANGLE
END
ω=36.6°
—— SAGITTAL
----TANGENTIAL
ASTIGMATISM (mm)

FIG.6A
EXAMPLE 1
WIDE-ANGLE
END
F/4.63
SPHERICAL
ABERRATION (mm)
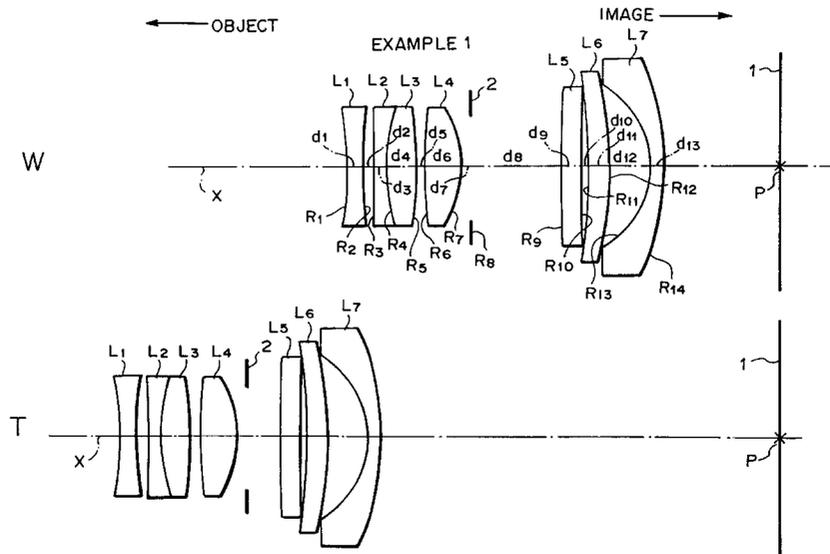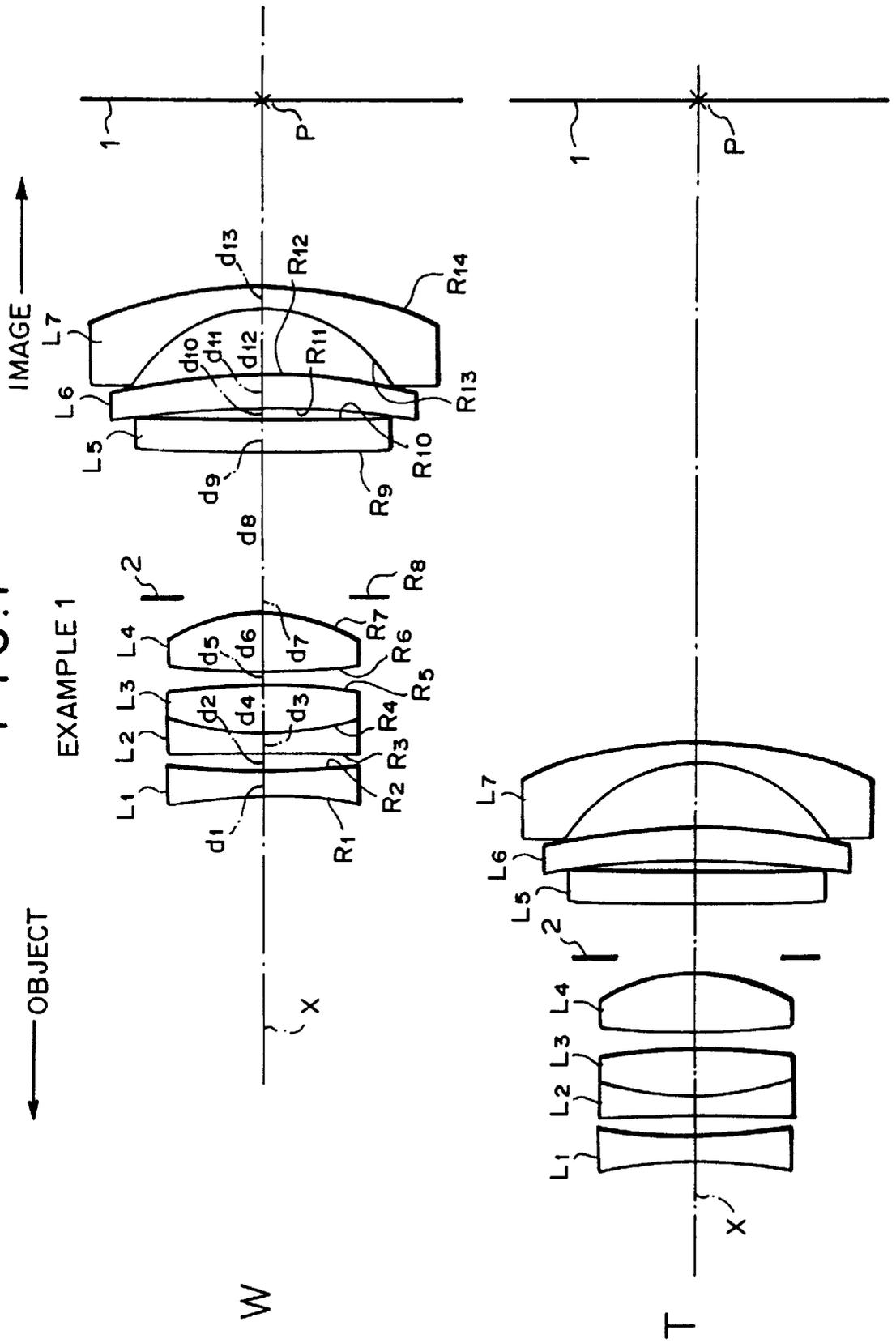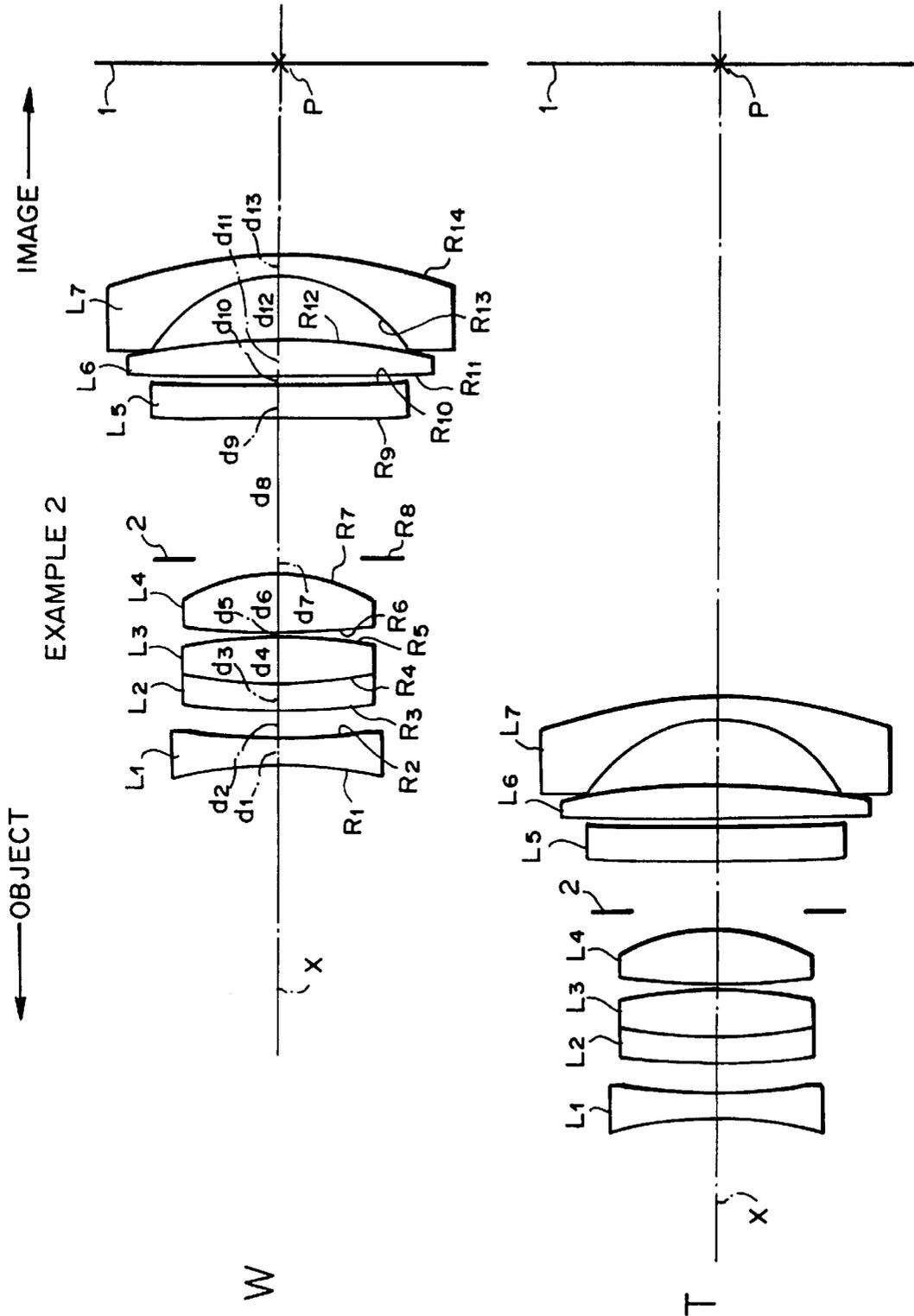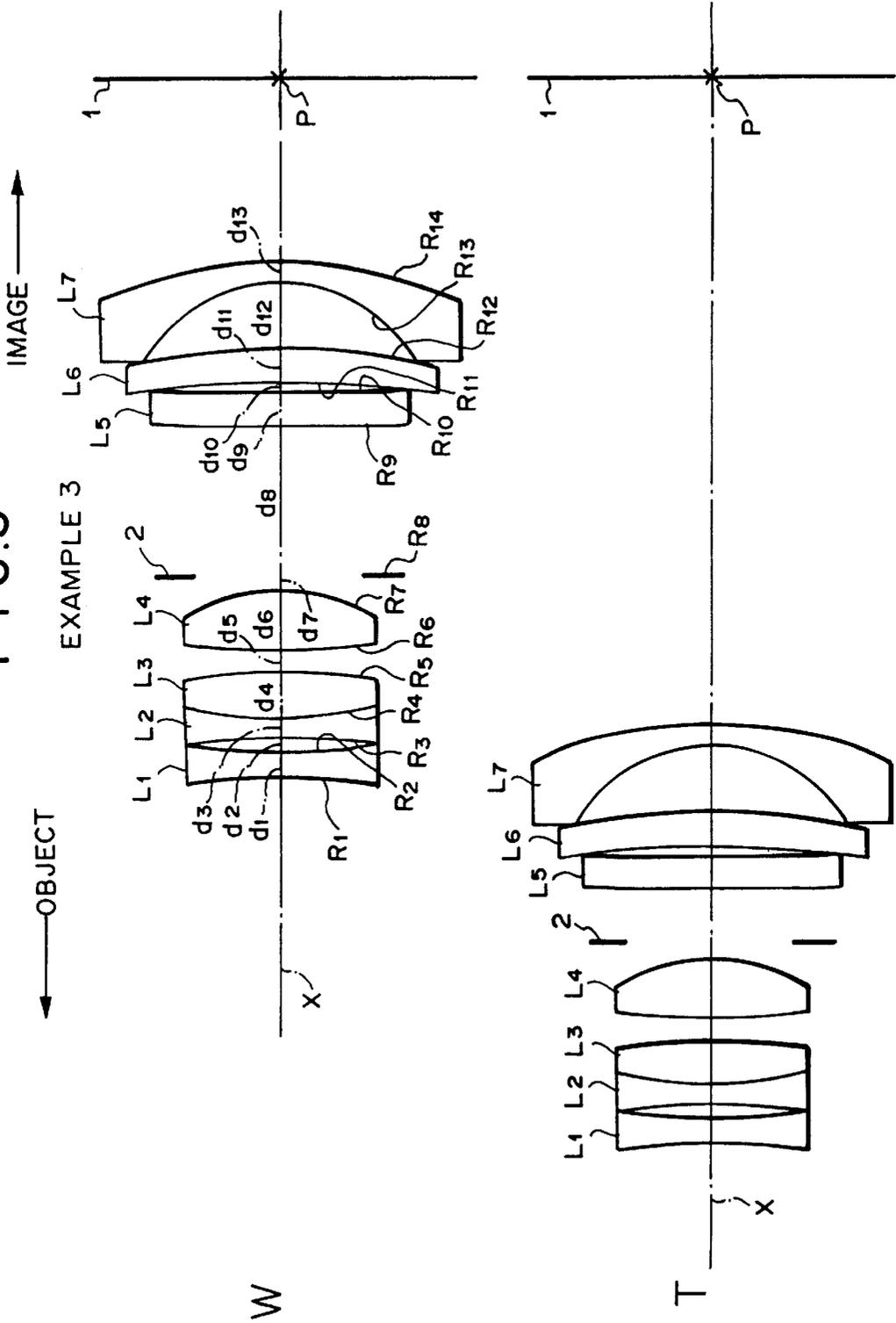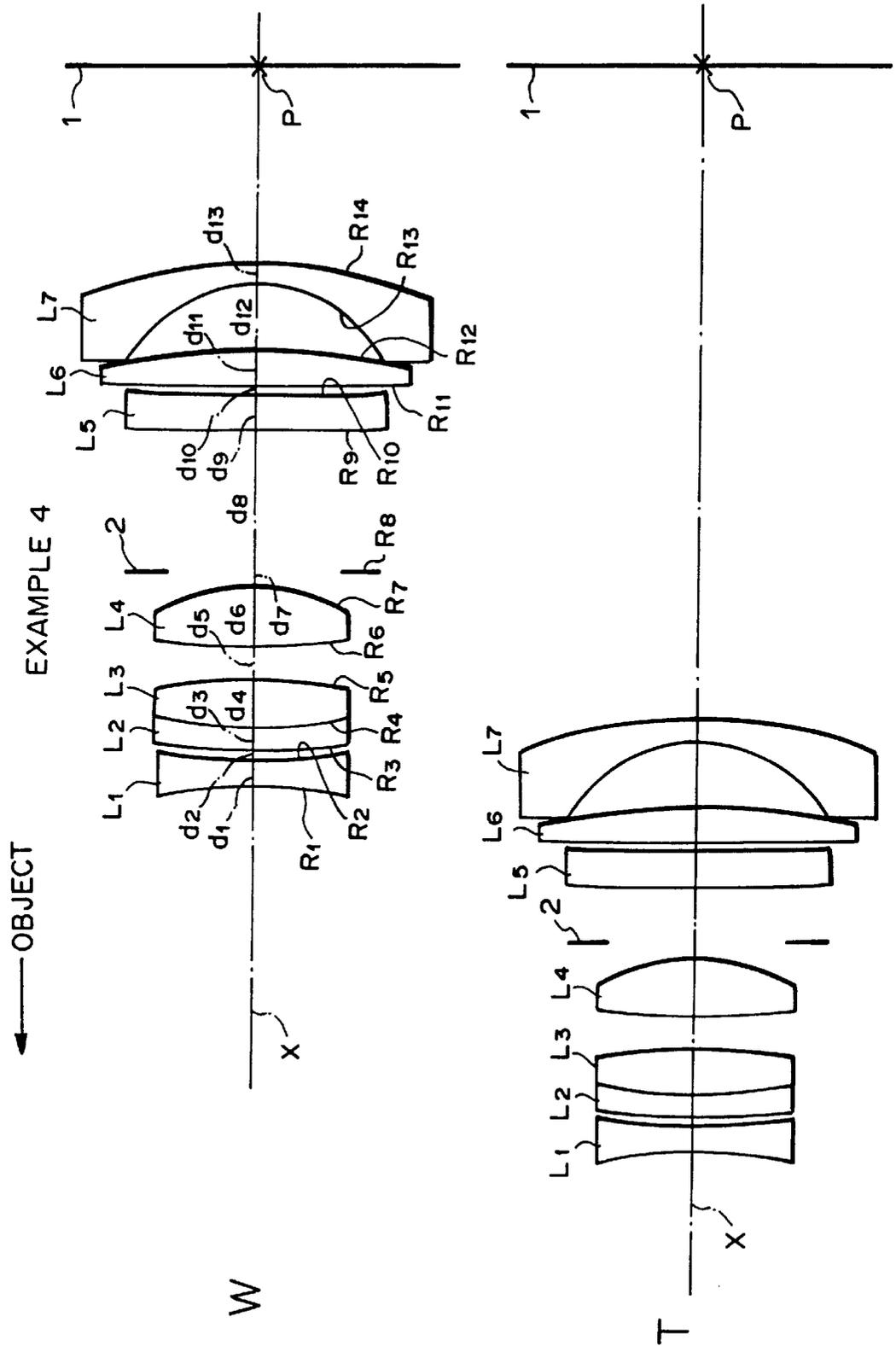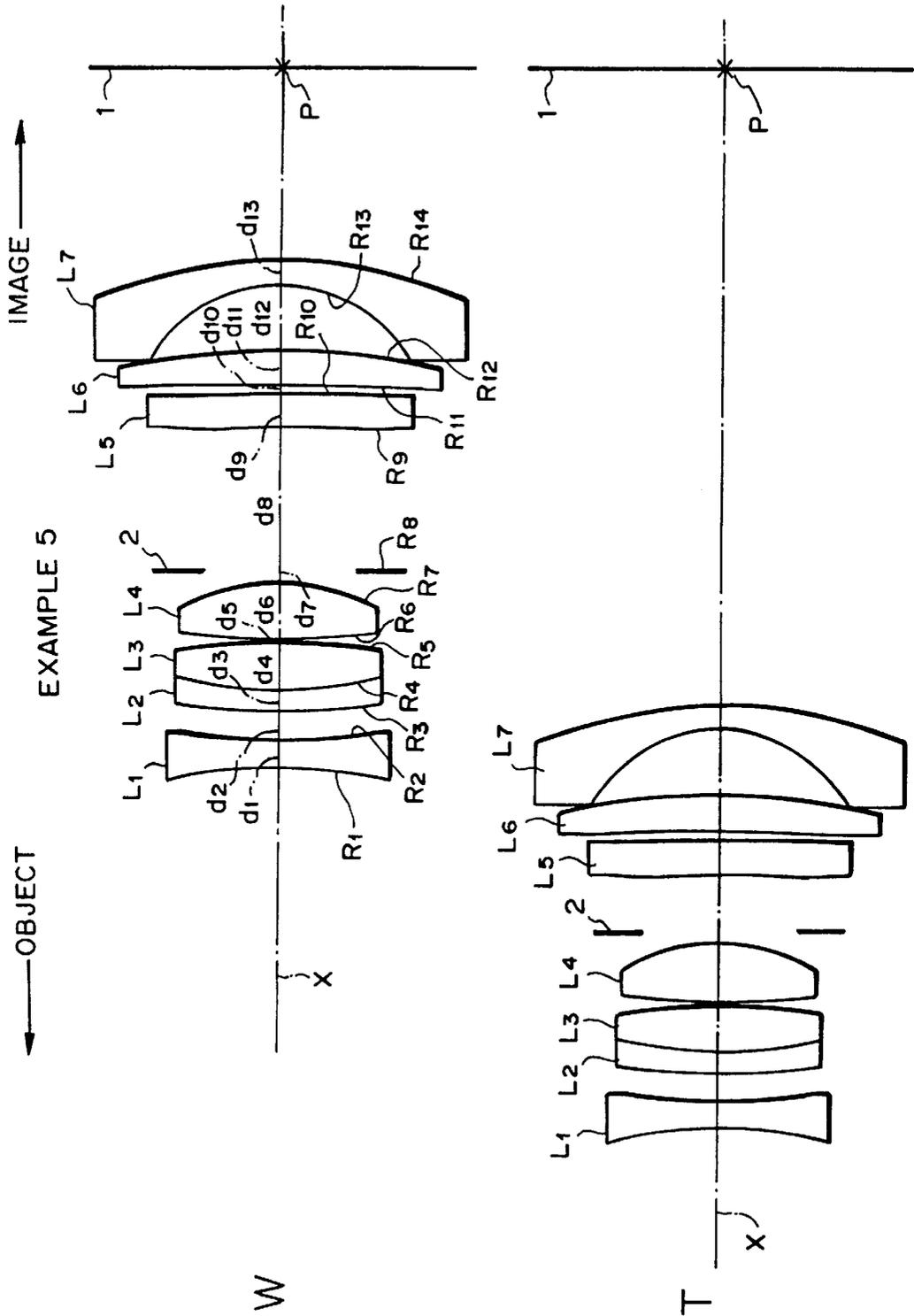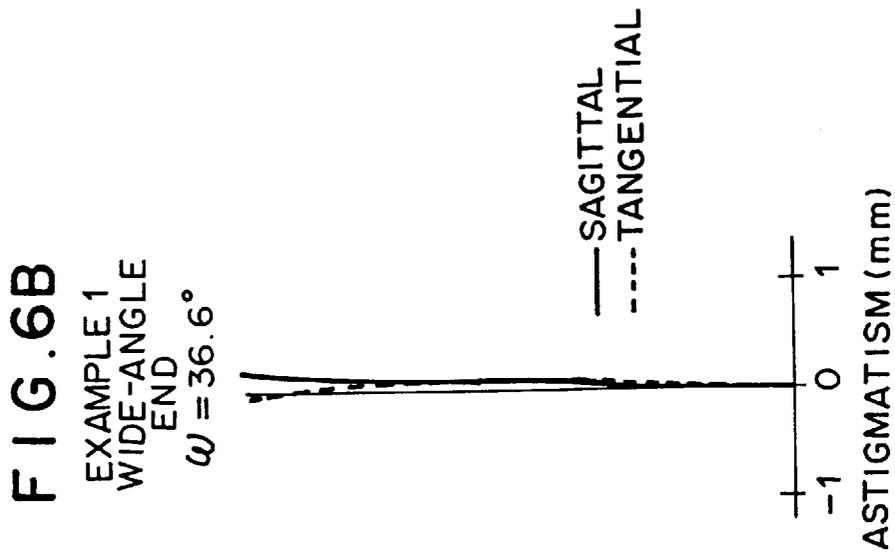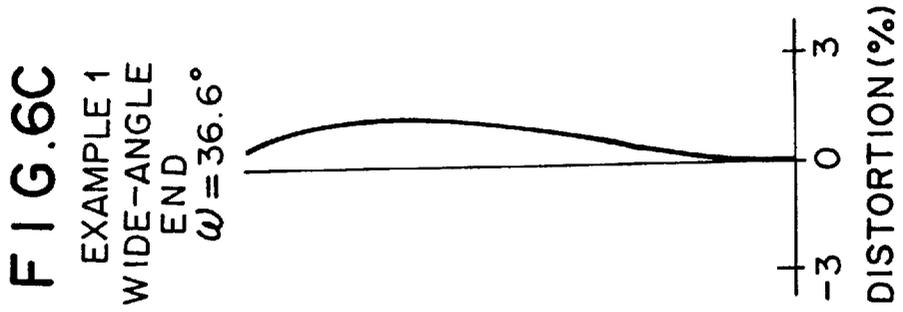
F I G. 7A

EXAMPLE 1
TELEPHOTO
END
F/7.79

SPHERICAL
ABERRATION (mm)

F I G.7B

EXAMPLE 1
TELEPHOTO
END
ω = 22.1°

SAGITTAL
TANGENTIAL

ASTIGMATISM (mm)
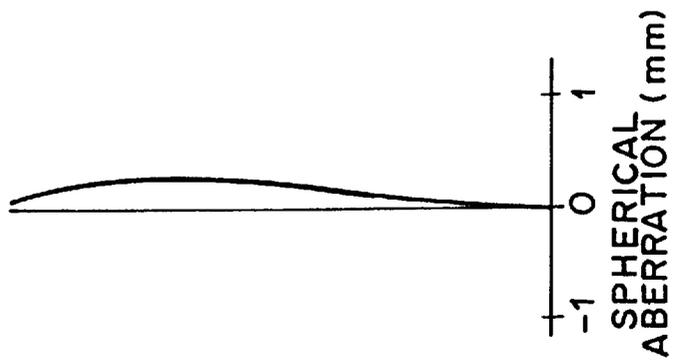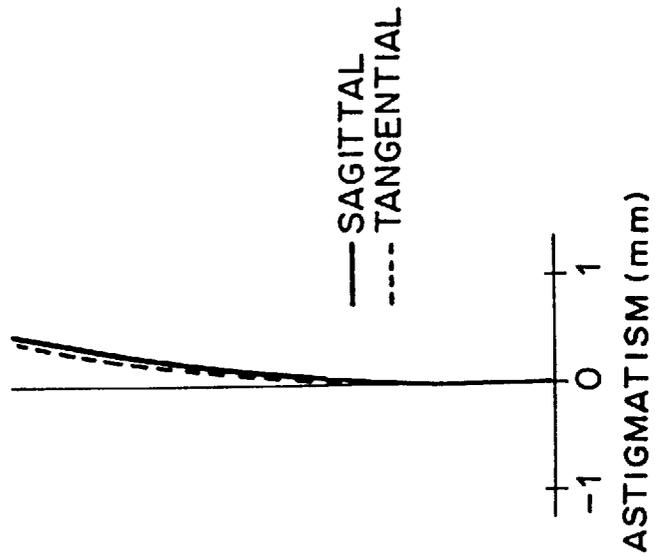
F I G.7C

EXAMPLE 1
TELEPHOTO
END
ω =22.1°

DISTORTION (%)

FIG.8A
EXAMPLE 2
WIDE-ANGLE END
F/4.63

SPHERICAL ABERRATION (mm)

FIG.8B
EXAMPLE 2
WIDE-ANGLE END
ω=36.4°

—— SAGITTAL
--- TANGENTIAL

ASTIGMATISM (mm)
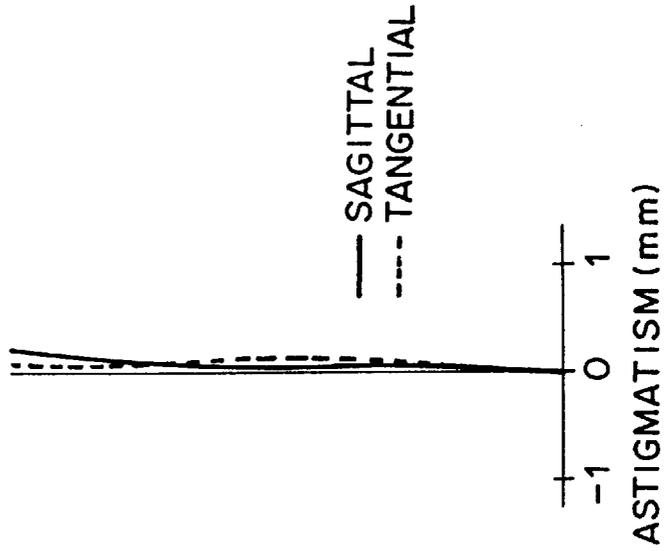
FIG.8C
EXAMPLE 2
WIDE-ANGLE END
ω=36.4°

DISTORTION (%)
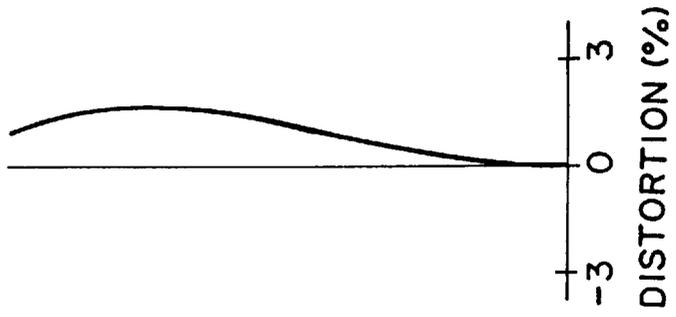
F I G.9C

EXAMPLE 2
TELEPHOTO
END
$\omega = 22.0°$

3

0

-3

DISTORTION (%)

F I G.9B

EXAMPLE 2
TELEPHOTO
END
$\omega = 22.0°$

SAGITTAL
TANGENTIAL

1

0

-1

ASTIGMATISM (mm)
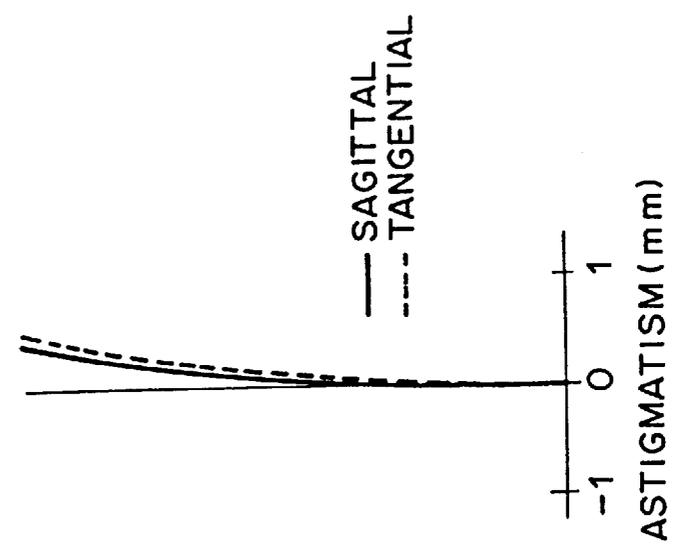
F I G.9A

EXAMPLE 2
TELEPHOTO
END
F/7.79

1

0

-1

SPHERICAL
ABERRATION (mm)
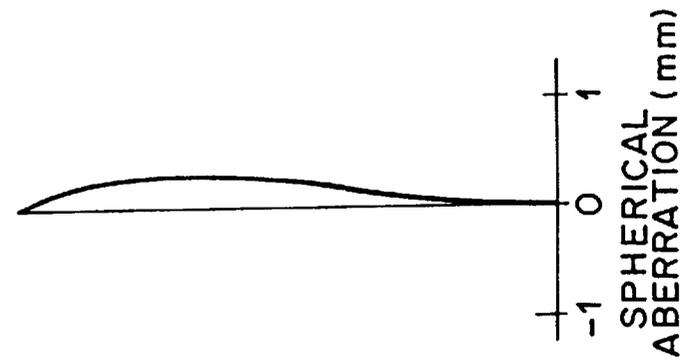
F I G. 10A

EXAMPLE 3
WIDE-ANGLE
END
F/4.63

SPHERICAL
ABERRATION (mm)

F I G. 10B

EXAMPLE 3
WIDE-ANGLE
END
ω =36.6°

—— SAGITTAL
----- TANGENTIAL

ASTIGMATISM (mm)
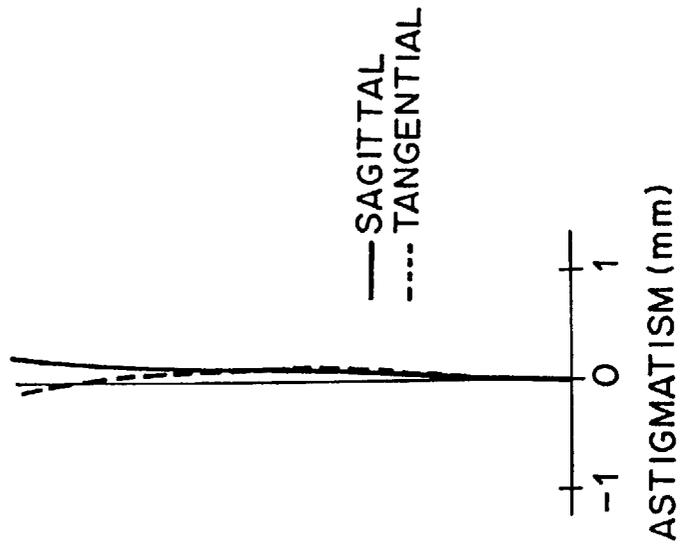
F I G. 10C

EXAMPLE 3
WIDE-ANGLE
END
ω =36.6°

DISTORTION (%)

FIG.11C
EXAMPLE 3
TELEPHOTO
END
$\omega = 22.1°$

DISTORTION (%)

FIG.11B
EXAMPLE 3
TELEPHOTO
END
$\omega = 22.1°$

—— SAGITTAL
---- TANGENTIAL

ASTIGMATISM (mm)
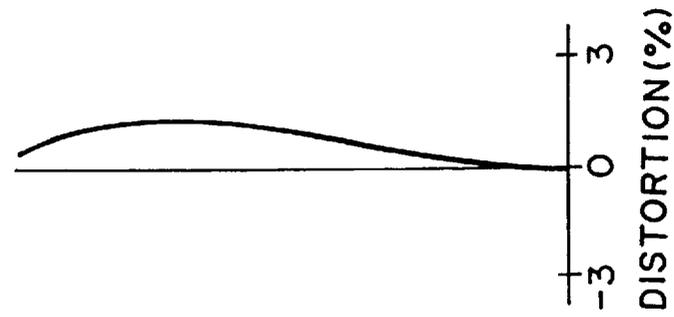
FIG.11A
EXAMPLE 3
TELEPHOTO
END
F/7.79

SPHERICAL
ABERRATION (mm)

F I G.12C
EXAMPLE 4
WIDE-ANGLE
END
ω=36.5°
DISTORTION (%)

F I G.12B
EXAMPLE 4
WIDE-ANGLE
END
ω=36.5°
——— SAGITTAL
----- TANGENTIAL
ASTIGMATISM (mm)

F I G.12A
EXAMPLE 4
WIDE-ANGLE
END
F/4.63
SPHERICAL
ABERRATION (mm)
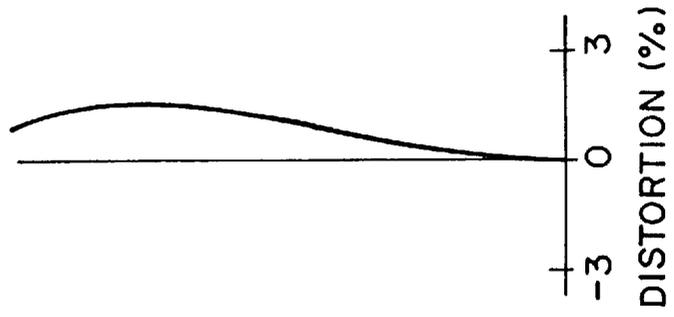
FIG.13A

EXAMPLE 4
TELEPHOTO
END
F/7.79

SPHERICAL
ABERRATION (mm)

FIG.13B

EXAMPLE 4
TELEPHOTO
END
$\omega = 22.0°$

—— SAGITTAL
---- TANGENTIAL

ASTIGMATISM (mm)
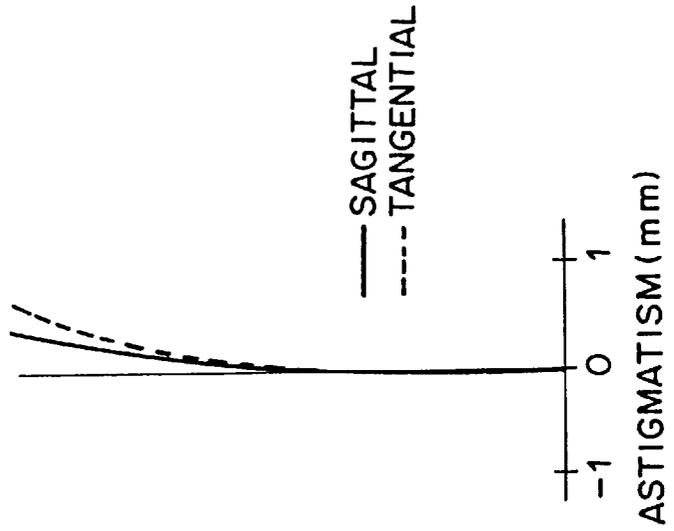
FIG.13C

EXAMPLE 4
TELEPHOTO
END
$\omega = 22.0°$

DISTORTION (%)

F I G.14C

EXAMPLE 5
WIDE-ANGLE
END
$\omega = 36.4°$

DISTORTION (%)

3

0

-3

F I G.14B

EXAMPLE 5
WIDE-ANGLE
END
$\omega = 36.4°$

——— SAGITTAL
- - - - TANGENTIAL

1

0

-1

ASTIGMATISM (mm)

F I G.14A

EXAMPLE 5
WIDE-ANGLE
END
F/4.63

1

0

-1

SPHERICAL
ABERRATION (mm)

F I G. 15A

EXAMPLE 5
TELEPHOTO
END
F/7.80

SPHERICAL
ABERRATION (mm)

F I G. 15B

EXAMPLE 5
TELEPHOTO
END
$\omega = 22.0°$

—— SAGITTAL
---- TANGENTIAL

ASTIGMATISM (mm)

F I G. 15C

EXAMPLE 5
TELEPHOTO
END
$\omega = 22.0°$

DISTORTION (%)

COMPACT WIDE-ANGLE ZOOM LENS

RELATED APPLICATIONS

This application claims the priority of Japanese Patent Application No. 8-324586 filed on Nov. 19, 1996, which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a compact wide-angle zoom lens for a lens shutter camera, which covers a wide angle area by two lens groups.

2. Description of the Prior Art

Recently, as a lens system used for lens shutter cameras, that loaded with a zoom lens has been becoming the mainstream. Since such a zoom lens requires its compactness in the first place, there has been put into practice a two-group zoom lens with a telephoto type of refracting power arrangement, comprising a first lens group with a positive refracting power and a second lens group with a negative refracting power.

Further, in such a telephoto type two-group zoom lens, known as the one intended for wider angle and more compactness is that disclosed in Japanese Unexamined Patent Publication No. 7-234363.

In the zoom lens disclosed in the above-mentioned publication, the F number at the wide-angle end is as dark as about 5.7, and the lens thickness (distance from the front-side lens surface of the first lens to the rear-side lens surface of the last lens on the optical axis) becomes large at the telephoto end.

SUMMARY OF THE INVENTION

In view of such circumstances, it is an object of the present invention to provide a compact wide-angle zoom lens which can yield a high brightness at its wide-angle end, a large angle of view, and a small lens thickness at its telephoto end.

The compact wide-angle zoom lens in accordance with the present invention comprises, successively from an object side, a first lens group having a positive refracting power and a second lens group having a negative refracting power, in which a distance between the lens groups is changed to attain a variable power;

wherein the first lens group comprises, successively from the object side, a biconcave negative first lens, a negative second lens, a biconvex positive third lens, and a biconvex positive fourth lens, the second and third lenses being cemented together;

wherein the second lens group comprises, successively from the object side, a fifth lens having at least one aspheric surface, a sixth lens having a positive meniscus form with a convex surface directed onto an image side, and a seventh lens having a negative meniscus form with a convex surface directed onto the image side; and
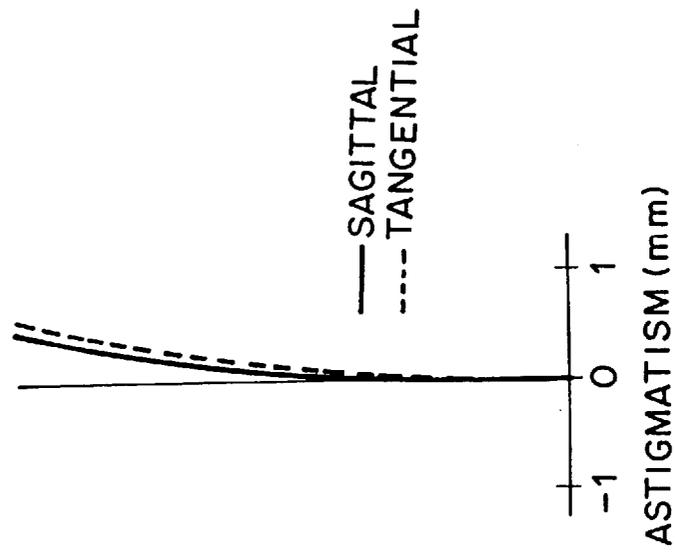
wherein the zoom lens satisfies the following conditional expressions:

$$0 < (r_3 + r_4)/(r_3 - r_4) < 3.5 \tag{1}$$

$$0.5 < (r_{11} + r_{12})/(r_{11} - r_{12}) < 4.5 \tag{2}$$

$$0.9 < |r_5/r_4| < 2.3 \tag{3}$$

$$n_1 > 1.65 \tag{4}$$

$$n_4 < 1.57 \tag{5}$$

wherein

r_3 is the radius of curvature of the object-side surface of said second lens

r_4 is the radius of curvature of the image-side surface of said second lens

r_5 is the radius of curvature of the image-side surface of said third lens

r_{11} is the radius of curvature of the object-side surface of said sixth lens

r_{12} is the radius of curvature of the image-side surface of said sixth lens

n_1 is the refractive index of said first lense

n_4 is the refractive index of said fourth lense

In order to cause each kind of aberration such as coma, image surface curvature, or the like to be favorable, it is preferred that the first lens have at least one aspheric surface.

In order to reduce the cost for making the fifth lens having an aspheric surface, it is preferred that the fifth lens be made of a plastic material.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG 1. is a schematic view showing a basic lens configuration in accordance with Example 1 of the present invention;

FIG. 2 is a schematic view showing a basic lens configuration in accordance with Example 2 of the present invention;

FIG. 3 is a schematic view showing a basic lens configuration in accordance with Example 3 of the present invention;

FIG. 4 is a schematic view showing a basic lens configuration in accordance with Example 4 of the present invention;

FIG. 5 is a schematic view showing a basic lens configuration in accordance with Example 5 of the present invention;

FIG. 6A, 6B, and 6C are aberration charts of the lens in accordance with Example 1 at its wide-angle end;

FIG. 7A, 7B, and 7C are aberration charts of the lens in accordance with Example 1 at its telephoto end;

FIG. 8A, 8B, and 8C are aberration charts of the lens in accordance with Example 2 at its wide-angle end;

FIG. 9A, 9B, and 9C are aberration charts of the lens in accordance with Example 2 at its telephoto end;

FIG. 10A, 10B, and 10C are aberration charts of the lens in accordance with Example 3 at its wide-angle end;

FIG. 11A, 11B, and 11C are aberration charts of the lens in accordance with Example 3 at its telephoto end;

FIG. 12A, 12B, and 12C are aberration charts of the lens in accordance with Example 4 at its wide-angle end;

FIG. 13A, 13B, and 13C are aberration charts of the lens in accordance with Example 4 at its telephoto end;

FIG. 14A, 14B, and 14C are aberration charts of the lens in accordance with Example 5 at its wide-angle end; and

FIG. 15A, 15B, and 15C are aberration charts of the lens in accordance with Example 5 at its telephoto end.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following, specific examples of the present invention will be explained with reference to the drawings.

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EXAMPLE 1

The compact wide-angle zoom lens in accordance with Example 1 shown in FIG. 1 (with its positions at wide-angle and telephoto ends being respectively indicated by W and T, as with the following FIGS. 2 to 5) comprises, successively from the object side, a first lens group L_1 to L_4 having a positive refracting power as a whole and a second lens group L_5 to L_7 having a negative refracting power as a whole. Upon zooming, the first lens group L_1 to L_4 and the second lens group L_5 to L_7 move along an optical axis X while changing the distance therebetween, thus changing the focal length f of the whole system and efficiently converging a luminous flux onto an imaging point P on an imaging surface 1. Here, a stop 2 is disposed downstream the first lens group L_1 to L_4.

The first lens group L_1 to L_4 comprises a biconcave negative first lens L_1; a cemented lens composed of a negative second lens L_2 and a biconvex positive third lens L_3; and a biconvex positive fourth lens L_4. The second lens group L_5 to L_7 comprises a fifth lens L_5 having an aspheric surface; a sixth lens L_6 having a positive meniscus form with a convex surface directed onto the image side; and a seventh lens L_7 having a negative meniscus form with a convex surface directed onto the image side.

Further, the following conditional expressions are satisfied:

$$0<(r_3+r_4)/(r_3-r_4)<3.5 \tag{1}$$

$$0.5<(r_{11}+r_{12})/(r_{11}-r_{12})<4.5 \tag{2}$$

$$0.9<|r_5/r_4|<2.3 \tag{3}$$

$$n_1>1.65 \tag{4}$$

$$n_4<1.57 \tag{5}$$

wherein

r_3 is the radius of curvature of the object-side surface of said second lens

r_4 is the radius of curvature of the image-side surface of said second lens

r_5 is the radius of curvature of the image-side surface of said third lens

r_{11} is the radius of curvature of the object-side surface of said sixth lens

r_{12} is the radius of curvature of the image-side surface of said sixth lens

n_1 is the refractive index of said first lense

n_4 is the refractive index of said fourth lense

Also, each surface of the first lens L_1 and fifth lens L_5 is shaped into an aspheric surface of a predetermined form. Further, the fifth lens L_5 is made of a plastic material.

In the following, the technical significance of each of the above-mentioned expressions will be explained.

Above the upper limit of conditional expression (1), chromatic aberration in magnification increases so much that it is hard to correct. Below the lower limit thereof, on the other hand, axial chromatic aberration increases so much that it is hard to correct.

Above the upper limit of conditional expression (2), coma increases so much that it is hard to correct, while its form becomes unfavorable in terms of productivity. Below the lower limit thereof, coma also increases so much that it is hard to correct.

Outside conditional expression (3), coma increases so much that it is hard to correct.

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Below the lower limit of conditional expression (4), coma and image surface curvature increase so that various kinds of aberration are hard to correct with a favorable balance.

Above the upper limit of conditional expression (5), image surface curvature increases so much that it is hard to correct.

Here, when each surface of the fifth lens is shaped into an aspheric surface, aberration such as distortion, image surface curvature, or the like can be made favorable.

In this example, as the configuration of each lens and the above-mentioned conditional expressions are satisfied as mentioned above, various kinds of aberration in any object distance ranging from long distance to near distance can be favorably corrected, thus yielding high optical performances throughout the object distance.

Table 1 (follows) shows the radius of curvature R (mm) of each lens surface, the center thickness of each lens and air gap between neighboring lenses (collectively referred to as "axial spacing" hereinafter) d (mm), and the refractive index n and Abbe number v of each lens at d-line in the zoom lens in accordance with this example.

In Table 1, the reference numbers successively increase from the object side.

Each of the surfaces marked with "*" on the right side of the surface number in Table 1 is shaped into an aspheric surface as mentioned above, which means that it is in an aspheric form represented by the following expression (A):

$$Z=CY^2/[1+(1-kC^2Y^2)^{1/2}]+AY^4+BY^6+CY^8+DY^{10} \tag{A}$$

wherein

Z is a length (mm) of a perpendicular on a tangent plane (plane perpendicular to an optical axis) of an apex of an aspheric surface from a point on the aspheric surface at a height Y from the optical axis;

C (1/R) is a paraxial curvature of the aspheric surface;

Y is a height (mm) from the optical axis;

k is an eccentricity; and

A, B, C, and D are aspheric surface coefficients of the fourth, sixth, eighth, and tenth orders, respectively.

Table 2 (follows) shows values of the constants A, B, C, D, and k of the aspheric surfaces indicated by the above-mentioned expression (A).

Further, the focal length f, F No, and angle of view 2ω of the whole lens system in this example are set as shown in Table 3 (follows).

EXAMPLE 2

The compact wide-angle zoom lens in accordance with Example 2 is configured so as to be substantially similar to that of Example 1, as shown in FIG. 2, and satisfy the above-mentioned conditional expressions (1) to (5).

Table 4 (follows) shows the radius of curvature R (mm) of each lens surface, the axial spacing d (mm), and the refractive index n and Abbe number v of each lens at d-line in the zoom lens in accordance with this example.

In Table 4, the reference numbers successively increase from the object side.

Each of the surfaces marked with "*" on the right side of the surface number in Table 4 is shaped into an aspheric surface, which means that it is in an aspheric form represented by the above-mentioned expression (A).

Table 5 (follows) shows values of the constants A, B, C, D, and k of the aspheric surfaces indicated by the above-mentioned expression (A).

Further, the focal length f, F No, and angle of view 2ω of the whole lens system in this example are set as shown in Table 6 (follows).

EXAMPLE 3

The compact wide-angle zoom lens in accordance with Example 3 is configured so as to be substantially similar to that of Example 1, as shown in FIG. 3, and satisfy the above-mentioned conditional expressions (1) to (5).

Table 7 (follows) shows the radius of curvature R (mm) of each lens surface, the axial spacing d (mm), and the refractive index n and Abbe number ν of each lens at d-line in the zoom lens in accordance with this example.

In Table 7, the reference numbers successively increase from the object side.

Each of the surfaces marked with "*" on the right side of the surface number in Table 7 is shaped into an aspheric surface, which means that it is in an aspheric form represented by the above-mentioned expression (A).

Table 8 (follows) shows values of the constants A, B, C, D, and k of the aspheric surfaces indicated by the above-mentioned expression (A).

Further, the focal length f, F No, and angle of view 2ω of the whole lens system in this example are set as shown in Table 9 (follows).

EXAMPLE 4

The compact wide-angle zoom lens in accordance with Example 4 is configured so as to be substantially similar to that of Example 1, as shown in FIG. 4, and satisfy the above-mentioned conditional expressions (1) to (5).

Table 10 (follows) shows the radius of curvature R (mm) of each lens surface, the axial spacing d (mm), and the refractive index n and Abbe number ν of each lens at d-line in the zoom lens in accordance with this example.

In Table 10, the reference numbers successively increase from the object side.

Each of the surfaces marked with "*" on the right side of the surface number in Table 10 is shaped into an aspheric surface, which means that it is in an aspheric form represented by the above-mentioned expression (A).

Table 11 (follows) shows values of the constants A, B, C, D, and k of the aspheric surfaces indicated by the above-mentioned expression (A).

Further, the focal length f, F No, and angle of view 2ω of the whole lens system in this example are set as shown in Table 12 (follows).

EXAMPLE 5

The compact wide-angle zoom lens in accordance with Example 5 is configured so as to be substantially similar to that of Example 1, as shown in FIG. 5, and satisfy the above-mentioned conditional expressions (1) to (5).

Table 13 (follows) shows the radius of curvature R (mm) of each lens surface, the axial spacing d (mm), and the refractive index n and Abbe number ν of each lens at d-line in the zoom lens in accordance with this example.

In Table 13, the reference numbers successively increase from the object side.

Each of the surfaces marked with "*" on the right side of the surface number in Table 13 is shaped into an aspheric surface, which means that it is in an aspheric form represented by the above-mentioned expression (A).

Table 14 (follows) shows values of the constants A, B, C, D, and k of the aspheric surfaces indicated by the above-mentioned expression (A).

Further, the focal length f, F No, and angle of view 2ω of the whole lens system in this example are set as shown in Table 15 (follows).

FIGS. 6, 8, 10, 12, and 14 are aberration charts showing various kinds of aberration (spherical aberration, astigmatism, and distortion) of the zoom lenses in accordance with the above-mentioned respective examples at their wide-angle end; whereas FIGS. 7, 9, 11, 13, and 15 are aberration charts showing various kinds of aberration (spherical aberration, astigmatism, and distortion) of the zoom lenses in accordance with the above-mentioned respective examples at their telephoto end. Here, each aberration chart concerning astigmatism shows aberrations with respect to sagittal (S) and tangential (T) image surfaces As can be seen from these aberration charts, each kind of aberration can be favorably corrected by the zoom lens in accordance with each of the above-mentioned examples.

The zoom lens of the present invention should not be restricted to the above-mentioned examples. For example, the forms of lenses constituting each lens group as well as the number and forms of the aspheric surfaces can be appropriately selected.

In the compact wide-angle zoom lens of the present invention, a lens system which is bright at its wide-angle end can be obtained in a simple and compact two-group configuration. Also, its angle of view can be made wide, and the lens thickness can be reduced at its telephoto end. Further, various kinds of aberration in any object distance ranging from long distance to near distance can be corrected favorably.

TABLE 1

	R	d	n	ν
1 *	−22.739	1.42	1.80247	33.74
2 *	499.990	0.93		
3	384615.385	1.10	1.57427	52.38
4	16.563	2.54	1.59401	55.96
5	−34.258	0.75		
6	50.000	3.08	1.48749	70.40
7	−9.256	0.80		
8	Stop	7.55 to 2.85		
9 *	−59.739	1.80	1.49020	57.49
10 *	−88.981	0.40		
11	−58.092	1.85	1.77517	26.24
12	−34.854	3.42		
13	−7.741	1.10	1.80165	44.04
14	−22.328			

f = 28.98 to 53.84 F No = 4.63 to 7.78 Angle of view 2ω = 44.2° to 73.2°

TABLE 2

Surface	A	B	C	D	k
1	1.4893935E − 04	1.8858483E − 06	−5.4474482E − 08	−9.6623714E − 10	3.1695353E − 01
2	4.4879218E − 04	5.1685176E − 06	7.6598626E − 08	−1.5885633E − 09	1.0010702E + 00
9	1.9929142E − 04	3.1515057E − 06	7.1395412E − 09	−1.5814644E − 11	8.9294278E − 01
10	5.7075468E − 05	9.1008351E − 07	2.4013161E − 08	−1.4017132E − 10	9.9993930E − 01

TABLE 3

Conditional expression
(1) 1.00
(2) 4.00
(3) 2.07
(4) 1.80
(5) 1.49

TABLE 4

	R	d	n	v
1 *	−22.239	1.42	1.76618	37.19
2 *	198.271	1.45		
3	51.503	1.36	1.78988	39.34
4	25.752	2.47	1.48500	65.44
5	−25.754	0.15		
6	50.000	3.03	1.48749	70.40
7	−9.551	0.80		
8	Stop	7.15 to 2.79		
9 *	−60.253	1.80	1.49020	57.49
10 *	−1978.114	0.40		
11	−5753.475	1.85	1.67652	31.68
12	−38.349	3.30		
13	−7.528	1.15	1.80035	46.41
14	−26.038			

f = 29.02 to 53.91 F No = 4.63 to 7.78 Angle of view 2ω = 44.0° to 72.8°

TABLE 5

Surface	A	B	C	D	k
1	5.1717118E − 05	2.2918629E − 06	−5.3465110E − 08	−6.0353960E − 10	6.4767161E − 01
2	3.5904770E − 04	4.9073562E − 06	6.2935548E − 08	−1.1480423E − 09	1.0007774E + 00
9	1.8966194E − 04	2.4385422E − 06	−1.8532359E − 08	1.0384508E − 09	8.9312212E − 01
10	1.8368083E − 05	6.6685513E − 07	−2.2503411E − 08	6.5933904E − 10	9.9685707E − 01

TABLE 6

Conditional expression
(1) 3.00
(2) 1.01
(3) 1.00
(4) 1.77
(5) 1.49

TABLE 7

	R	d	n	v
1 *	−32.331	1.42	1.80500	28.85
2 *	500.007	0.68		
3	−30.515	1.10	1.48500	62.11
4	20.313	2.46	1.55616	57.95
5	−29.264	1.15		
6	50.000	3.07	1.48749	70.40
7	−9.230	0.80		
8	Stop	8.10 to 2.94		
9 *	−54.583	1.80	1.49020	57.49
10 *	−67.319	0.40		
11	−58.164	1.85	1.71564	29.22
12	−34.898	3.45		
13	−8.031	1.10	1.80500	44.88
14	−22.526			

f = 29.02 to 53.91 F No = 4.63 to 7.78 Angle of view 2ω = 44.2° to 73.2°

TABLE 8

Surface	A	B	C	D	k
1	1.7611837E − 04	1.6135279E − 06	−3.9297525E − 08	−1.4670743E − 09	2.7462447E − 01
2	4.7943595E − 04	5.5145925E − 06	8.5799181E − 08	−1.4859383E − 09	1.0010682E + 00
9	1.9884960E − 04	3.3184114E − 06	−1.6104725E − 08	2.5033932E − 10	8.9285145E − 01
10	7.1462984E − 05	9.6859141E − 07	1.7435756E − 08	−5.5237571E − 11	9.9883285E − 01

TABLE 9

Conditional expression
(1) 0.20
(2) 4.02
(3) 1.44
(4) 1.81
(5) 1.49

TABLE 10

	R	d	n	v
1 *	−22.793	1.42	1.80500	32.77
2 *	204.891	0.42		
3	57.284	1.10	1.80029	47.97
4	24.752	2.39	1.48500	64.38
5	−28.250	1.71		
6	50.000	2.96	1.55000	63.08
7	−10.014	0.80		
8	Stop	7.17 to 2.94		
9 *	−61.731	1.80	1.49020	57.49
10 *	−973.410	0.40		
11	−7836.991	1.85	1.61018	36.98
12	−37.179	3.27		
13	−7.584	1.10	1.80500	43.94
14	−25.266	0.00		

f = 29.02 to 53.91 F No = 4.63 to 7.78 Angle of view 2ω = 44.0° to 73.0°

TABLE 13

	R	d	n	v
1 *	−20.760	1.42	1.73077	40.50
2 *	479.505	1.50		
3	44.189	1.10	1.66998	39.28
4	19.740	2.51	1.48749	70.40
5	−31.313	0.13		
6	49.995	3.02	1.48749	70.40
7	−9.455	0.60		
8	Stop	7.29 to 2.94		
9 *	−47.778	1.80	1.4902	57.49
10 *	−122.278	0.40		
11	−119.690	1.85	1.71736	29.50
12	−35.548	3.33		
13	−7.468	1.31	1.80235	46.70
14	−23.811	0.00		

f = 29.04 to 53.94 F No = 4.63 to 7.80 Angle of view 2ω = 44.0° to 72.8°

TABLE 11

Surface	A	B	C	D	k
1	7.7553659E − 05	2.2604618E −06	−3.9610842E − 08	−9.4979943E − 10	5.7667953E − 01
2	3.5121499E − 04	5.0522535E − 06	4.3382877E − 08	−1.5649000E − 09	1.0007357E + 00
9	1.8984713E − 04	2.5882822E − 06	−6.2083803E − 08	5.8822874E − 10	8.9305591E − 01
10	2.5735711E − 05	7.4955040E − 07	−8.0105852E − 09	3.2724826E − 10	9.9683721E − 01

TABLE 12

Conditional expression
(1) 2.52
(2) 1.01
(3) 1.14
(4) 1.81
(5) 1.55

TABLE 14

Surface	A	B	C	D	k
1	1.1624710E − 04	2.1260080E − 06	−5.9254950E − 08	−8.3258276E −10	4.2600602E − 01
2	4.3120367E − 04	5.0791643E − 06	8.0363946E − 08	−1.9229663E − 09	1.0010120E + 00
9	2.0231963E − 04	2.9339466E − 06	−2.2676329E − 08	7.3768857E − 10	8.9073820E − 01
10	3.4988155E − 05	5.3467995E − 07	−5.4252425E − 09	1.8383392E − 10	1.0006530E + 00

TABLE 15

Conditional expression
(1) 2.61
(2) 1.84
(3) 1.59
(4) 1.73
(5) 1.49

What is claimed is:

1. A compact wide-angle zoom lens comprising, successively from an object side, a first lens group having a positive refracting power and a second lens group having a negative refracting power, in which a distance between said lens groups is changed to attain a variable power;

wherein said first lens group comprises, successively from the object side, a biconcave negative first lens, a negative second lens, a biconvex positive third lens, and a biconvex positive fourth lens, said second and third lenses being cemented together;

wherein said second lens group comprises, successively from the object side, a fifth lens having at least one aspheric surface, a sixth lens having a positive meniscus form with a convex surface directed onto an image side, and a seventh lens having a negative meniscus form with a convex surface directed onto the image side; and

wherein said zoom lens satisfies the following conditional expressions:

$$0<(r_3+r_4)/(r_3-r_4)<3.5 \tag{1}$$

$$0.5<(r_{11}+r_{12})/(r_{11}-r_{12})<4.5 \tag{2}$$

$$0.9<|r_5/r_4|<2.3 \tag{3}$$

$$n_1>1.65 \tag{4}$$

$$n_4<1.57 \tag{5}$$

wherein

r_3 is the radius of curvature of the object-side surface of said second lens

r_4 is the radius of curvature of the image-side surface of said second lens

r_5 is the radius of curvature of the image-side surface of said third lens

r_{11} is the radius of curvature of the object-side surface of said sixth lens

r_{12} is the radius of curvature of the image-side surface of said sixth lens

n_1 is the refractive index of said first lens

n_4 is the refractive index of said fourth lens.

2. A compact wide-angle zoom lens according to claim 1, wherein said first lens has at least one aspheric surface.

3. A compact wide-angle zoom lens according to claim 1, wherein said fifth lens is made of a plastic material.

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